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Forestry Research West

A report for land managers on recent developments in forestry research at the four western Experiment Stations of the Forest Service, U.S. Department of Agriculture.

Forestry Research West

In This Issue

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A complicated sprinkler system that simulates a rain shower is helping scientists at the Intermountain Station compare the effect of precipitation at different intensities on a variety of road surfaces and designs. It's all part of an effort to ensure that forest Service roads built today do not develop into expensive, damaging eyesores. Details begin on page 10.

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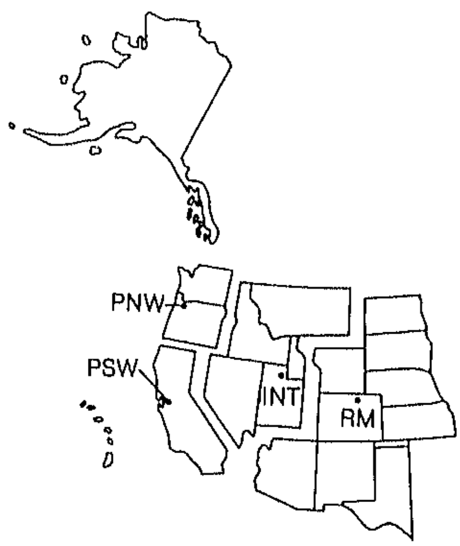
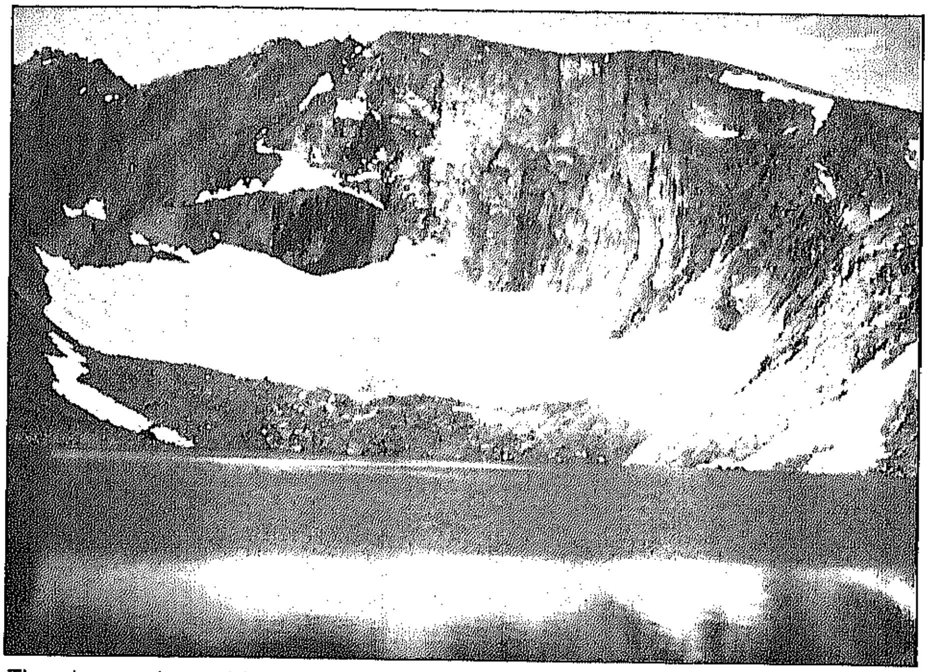


Lessons from a snowpack

by Rick Fletcher
Rocky Mountain Station



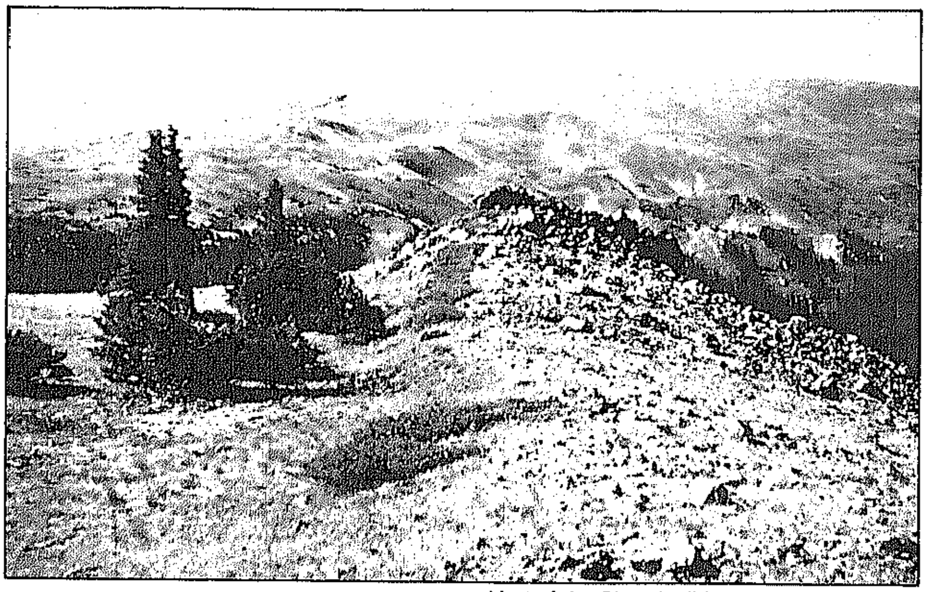
High mountain lakes, especially those surrounded by little vegetation and granitic soils are suspected of being most susceptible to atmospheric deposition.

There's growing evidence that air pollution is finding its way into many remote and "wild" areas of the mountain West. You don't have to look far to find environmental experts who are becoming increasingly concerned over what effects this is having on the various ecosystems. Much of the concern is based on what has happened in parts of the eastern United States, Canada, and Europe, where studies show that atmospheric pollutants have altered and/or damaged natural ecosystems. For example, scientists have found that acidic rain and snow in high enough concentrations can lower the pH of lakes to levels that reduce fish populations. Other studies indicate a correlation between acid deposition and the health of forest trees.

Because of these concerns, Congress charged the USDA Forest Service (1977 Clean Air Act) with protecting air quality-related values of wilderness areas managed by that agency.

Part of this national effort is spearheaded by a group of scientists at the Rocky Mountain Station in Fort Collins, Colorado. Doug Fox, who heads the project—Atmospheric Deposition in Natural Ecosystems of the Western United States—says, "The effects of atmospheric pollutants on western ecosystems have not been studied adequately, and we're far from understanding all the processes involved. About all we are sure of is that air pollution does exist to varying degrees in parts of the mountain West, and, possibly due to population and industrial growth, emissions are on the increase. Beyond that, it's mostly theories and speculation."

Most of the Class I (wilderness) areas requiring protection are in alpine and subalpine environments. Over 90 percent of the precipitation that falls in these areas begins as snow. One of the major efforts Fox and his colleagues are undertaking is to understand how atmospheric chemicals are incorporated into snowpacks, and subsequently find their way into waterways and other parts of the environment.



Most of the Class I wilderness areas needing protection are in alpine (shown here) and subalpine environments.

Since a cubic meter of snowpack contains up to 100,000 square meters of ice surface, it has tremendous potential to store deposited chemicals that may build up during the winter months.

Verifying an hypothesis

Geologist Dick Sommerfeld, who is in charge of this part of the project's mission, explains, "Our hypothesis is that chemicals entering the ecosystem either via precipitation or by dry deposition (carried by wind currents) accumulate in the snowpack, where some may be transformed into other compounds. They are then released into the environment during snowmelt. We want to find out if this is in fact true, and better understand the processes involved."

In alpine and subalpine environments, precipitation is stored in the snowpack for several months. Since a cubic meter of snowpack typically contains 10,000 to 100,000 m2 of ice surface, it has a tremendous potential to store deposited chemicals that may build up during the winter months.

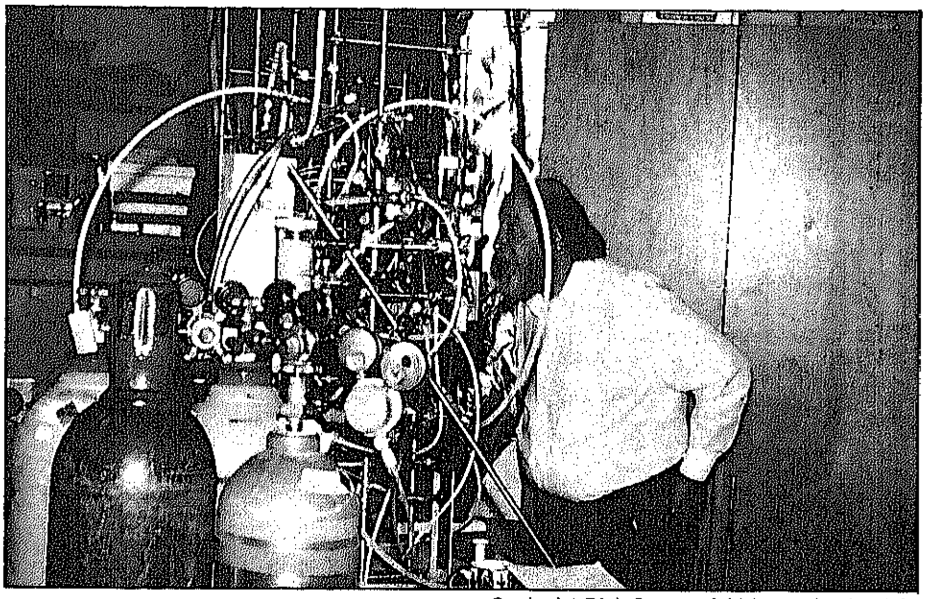
"However", said Sommerfeld, "we know very little about ice surface processes, and even less about how and to what degree chemicals are adsorbed into the snowpack, and the subsequent interactions between pollutants on ice surfaces."

Since the surfaces of ice crystals are the first contact point for pollutants, it is this interaction that Sommerfeld is most concerned with. "If we can determine to what extent pollutants are adsorbed by the snowpack, how they move within the snowpack, and how they are released during melt, we can better identify the long-term effects on ecosystems," he said.

SO_2 Studied

So far, studies have focused on sulfur dioxide (SO_2) because it is one of the most common pollutants. Working with artificial snowpacks in the laboratory, and using gas chromatography, Sommerfeld is comparing the retention of SO_2 in ice-filled tubes to that of tubes containing only clean air. "The temperature of the ice surface is an important factor," said Sommerfeld. "At warmer temperatures (−3 degrees C.) a 'quasi-liquid' surface exists on the ice. It appears that this surface is much more conducive to adsorption than the crystalline surface that exists at colder temperatures (−30 degrees C.). In fact, we found 30-50 times more SO_2 adsorbed on the quasi-liquid surface. From this, we can deduce that larger increases in deposition might be expected at temperatures above −3 degrees C. Such information can help predict the concentration of SO_2 in snowmelt, and how much will be available to affect other elements of the ecosystem," he said.

In addition to studying the surface chemistry of ice, Sommerfeld is conducting lab experiments and using a computer model to learn how pollutants behave at different depths within snowpacks under varying conditions.



Geologist Dick Sommerfeld is conducting lab experiments to study the adsorption rate of SO_2 by ice crystals.

Temperatures inside a snowpack are typically colder near the surface and warmer near the ground. These varying temperatures cause vapors to move from the upper cold layers to the lower warm layers or vice versa, depending on the chemical makeup of the vapor. In cooperation with the U.S. Geological Survey Isotope Geology Laboratory in Denver, Colorado, Sommerfeld is using naturally occurring isotopes to track these vapor flows. Results from this research are being verified using a computer simulation of vapor flow processes. (The computer model is being developed and used in cooperation with the Department of Mechanical Engineering, Colorado State University).

"Early results indicate that SO_2 moves to the lower, warmer layers of the snowpack," said Sommerfeld. "From this, we can assume that SO_2 is likely to be one of the first pollutants to enter spring and summer runoff."

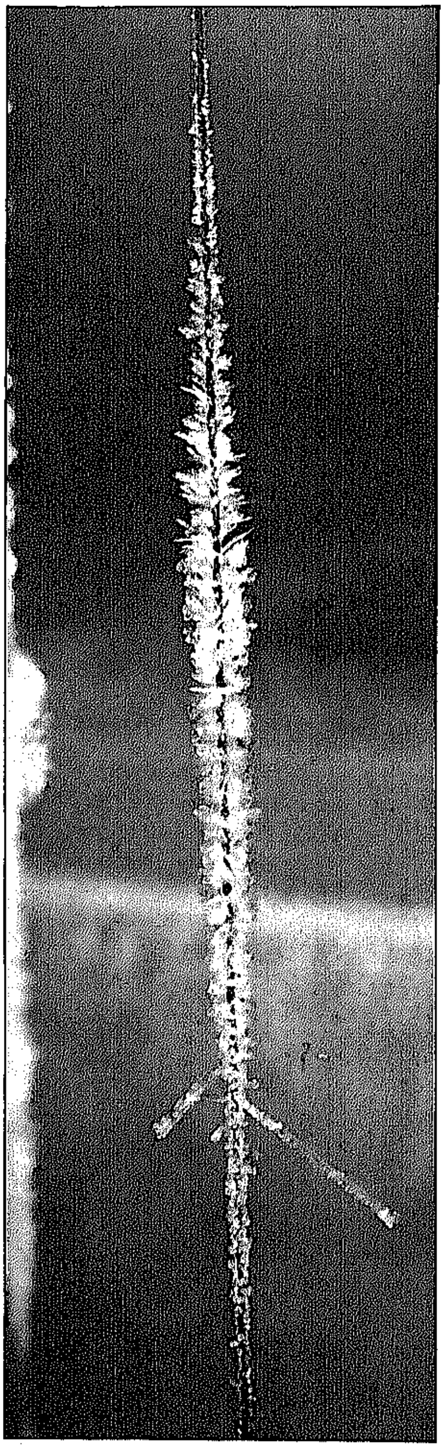
Although this is just one piece of the overall puzzle that Fox, Sommerfeld and other project scientists are working on, it is one of many necessary steps needed to help understand the effects of atmospheric deposition on western ecosystems.

Other studies

Other scientists with this project are conducting related studies. For instance, research is underway near high mountain lakes in the Rockies that are surrounded by granite, quartzite, or other non-reactive (unable to neutralize acidic pollutants) soils and rocks. Such lakes are thought to be more sensitive to acid deposition in that increases in deposition can cause relatively large changes in the pH level of these waters and possibly affect aquatic biota.

In terrestrial ecosystems, scientists are studying how pollutants affect soil chemical processes and plant communities. Results from these studies will be used in computer models to predict how much pollution will actually reach an ecosystem, and what the consequences of added pollution might be.

Finally, Fox and his group are heading and effort to bring together resource specialists, government leaders, and industry representatives from around the country to develop handbooks and directives that will standardize data collection and interpretation.



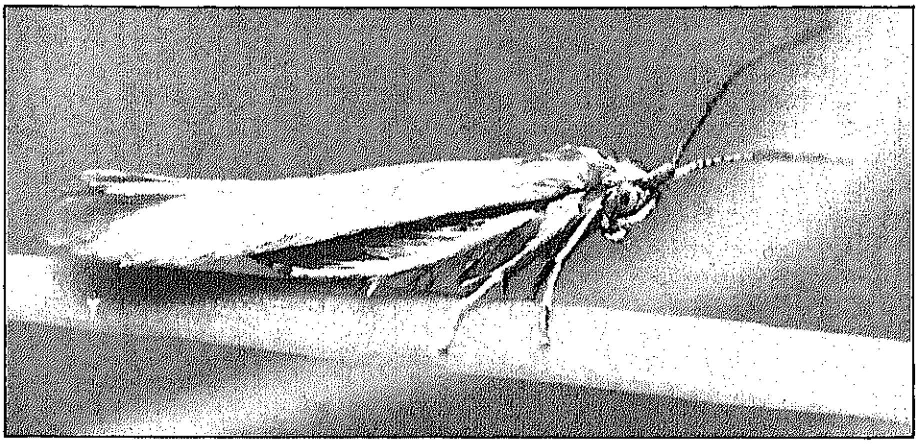
As part of the effort to understand the interactions between air pollutants and ice crystals, scientists are exposing lab produced crystals to nitric acid vapor to see if the compound has any effect on crystal shape.

This research project is part of the Forest Service component of a large program on acid deposition research, being conducted under the auspices of the National Acid Precipitation Assessment Program (NAPAP). The Program is a multi-agency, multi-discipline effort lead by the National Oceanic and Atmospheric Administration, Environmental Protection Agency, U.S. Department of Interior, Department of Energy, and U.S. Department of Agriculture.

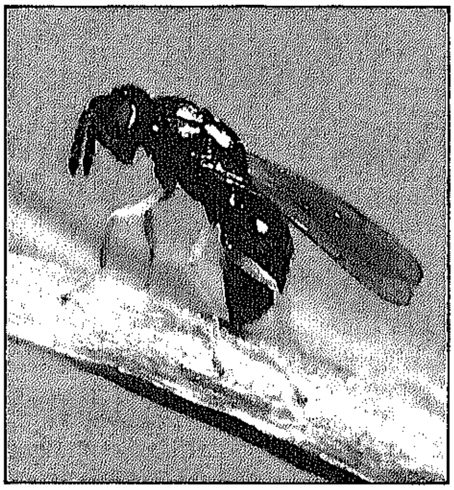
For more information on the atmospheric deposition project, contact Doug Fox at the Rocky Mountain Forest and Range Experiment Station, 240 West Prospect Road, Fort Collins, Colorado, 80526-2098, (303) 224-1231, FTS-323-1231.

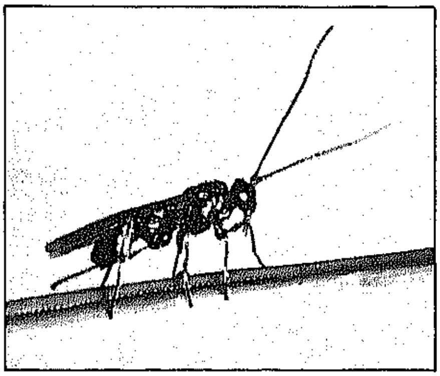
Biological control of the larch casebearer

by Dorothy Bergstrom
Pacific Northwest Station



The larch casebearer moth and the two most successful parasites: Chrysocharis laracinellae *(left) and* Agathis pumila.





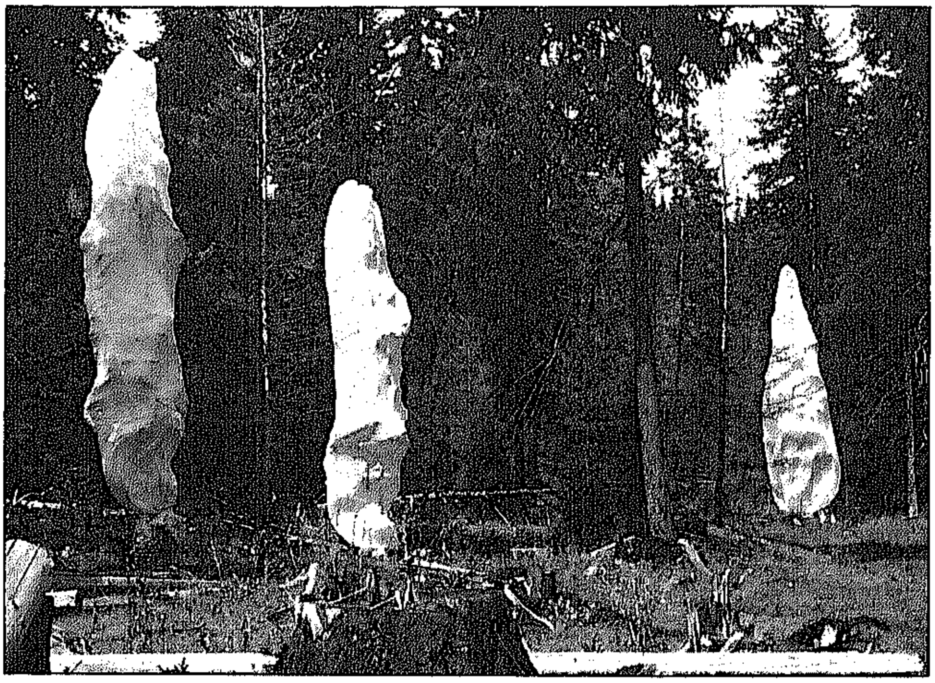
The best way to control an introduced forest insect pest is to import and release natural enemies from the pest's native country, according to Roger Ryan, Pacific Northwest Station entomologist. Ryan's conviction is based on his knowledge of almost a century of biological control work and on his own 25 years of personal research on pests such as the larch casebearer (*Coleophora laricella*), an insect that feeds on and defoliates western larch (Larix occidentalis). Since 1972, Ryan has imported, raised, and released seven species of parasitic wasps of the larch casebearer, in what has become one of the most successful efforts to control a forest insect in this country.

Because imported insects may take a long time to become established, it has been only recently that Ryan has been sure that the introduced parasites are providing control—even though they were first released 25 years ago. "We are now confident that decreases in casebearer damage in the last decade are due to the action of introduced parasites," Ryan says. "Aside from possible temporary flareups, the casebearer should no longer be a problem." Ryan had predicted the decline of the casebearer several years ago (*Forestry Research West*, July 1978) on the basis of results of a 1977 survey, but it was not until the past 2 years that research in Oregon showed dramatic increases in two parasites—*Agathis pumila* and *Chrysocharis laricinellae* —coincident with a decline in the casebearer.

Working first at the Forestry Sciences Laboratory in Corvallis, Oregon, and later at the Forestry and Range Sciences Laboratory in La Grande, Oregon, Ryan has succeeded in establishing at least one European parasite and has developed methods for the laboratory rearing of casebearers, parasites, and larch trees.

Ryan's research experience has convinced him that certain procedures are essential to a successful program of biological control. First, he says, it is important to release a number of enemy species until one or more are found to be effective; it may also take several species to control the insect pest throughout its range. Second, it is important to evaluate the status of the insect pest before enemies are released and to continue regular evaluations until populations of both pest and enemies stablize at new levels. Third, it is extremely helpful to be able to raise the pest and candidate enemy species in the laboratory. And finally, cooperation and support from other scientists and land managers is essential.

Parasites to control the larch casebearer were first released in the West in 1960 by scientists at Intermountain Station. Control efforts were based on methods that had been successful in the 1930's with the casebearer in the Eastern United States. The parasite *Agathis pumila* was introduced first because it had been most successful in the East. Once recoveries of *A. pumila* in 1962 and 1963 confirmed its adaptation to the western environment, managers in the Northern Region of the Forest Service embarked on a massive effort to increase its numbers and distribute it throughout the infestation. A program of field rearing and distribution spread *A. pumila* to about 300 sites in Washington, Idaho, and Montana.



Before Ryan established techniques for rearing parasites in the laboratory, they were reared in the forest in cages of fine mesh cloth.

Laboratory rearing proves complex

When Ryan joined the control effort in Corvallis in 1972, *A. pumila* was doing a farily good job of reducing the casebearer in some places in the West but was not doing well in others. And because no systematic evaluations were being made, there was no solid evidence that *A. pumila* alone would eventually control the casebearer.

Control seemed urgent. By that time, the casebearer had spread through the remaining Western States and British Columbia and had become the most important pest of western larch.

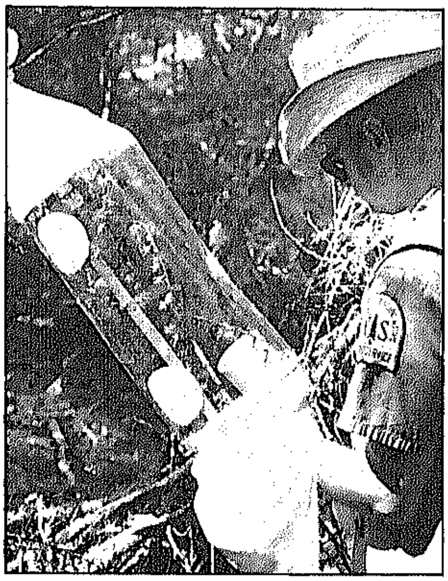
During the 1960's and 70's, defoliation was reducing larch growth as much as 95 percent in heavily infested stands and causing monetary losses estimated at $3 to $10 million per year. By the late 1960's, forest managers were considerinng favoring other species in their cutting and regeneration practices, even though larch is an important timber species and is cut and marketed with Douglas-fir.

Ryan decided to try introducing additional natural parasites from the Eastern United States and Europe. He also decided to try rearing parasites in the laboratory, which had not been done before. Ryan had raised other insects in the laboratory and was convinced that was necessary to increase the number of parasites available for release.

But, as often happens, one problem in research leads to another. To raise parasites, Ryan neeeded a supply of casebearers. To raise casebearers, he needed a continuous supply of larch needles—even in winter when the tree has none. Thus, culturing larch trees became the first problem. After experimenting with several combinations of photoperiod and temperature, he succeeded in getting the larch trees to grow needles (flush) on demand. Then by staggering the time that different trees flushed, he was able to provide a continuous supply of needles at the appropriate developmental stage for the casebearer diet.

After solving the food supply problem, Ryan was able to manipulate photoperiod to raise three generations of casebearers a year. With larch trees producing needles on demand and casebearers reproducing regularly, he was finally ready to import candidate parasites and begin raising them.

Rearing insect parasites in the laboratory offers advantages in addition to increasing the size of releases. Parasites can be released at selected locations and at times when the host is most susceptible. Undesirable foreign insects that may have accidentally slipped through quarantine with the imported insects can be detected if at least one generation is raised in the laboratory before releases are made. Laboratory culture also offers the opportunity to study the biology of insects and discover facts about their life cycles that contribute to success in raising, mating, and releasing them. It also permits crossing of species from different sources. Crossing sometimes reveals new species; insects that are assumed to be the same species may, in fact, be different. When this happens, an additional species becomes available for trial.



Technician Bob Oakes of Intermountain Station's lab in Moscow, Idaho, releases larch casebearer parasites in the forest.

Releasing several parasites is desirable

Ryan advocates working with several species of parasite because scientists cannot tell in advance which ones will adapt to local conditions and become established. Moreover, some species do better in some localities than in others.

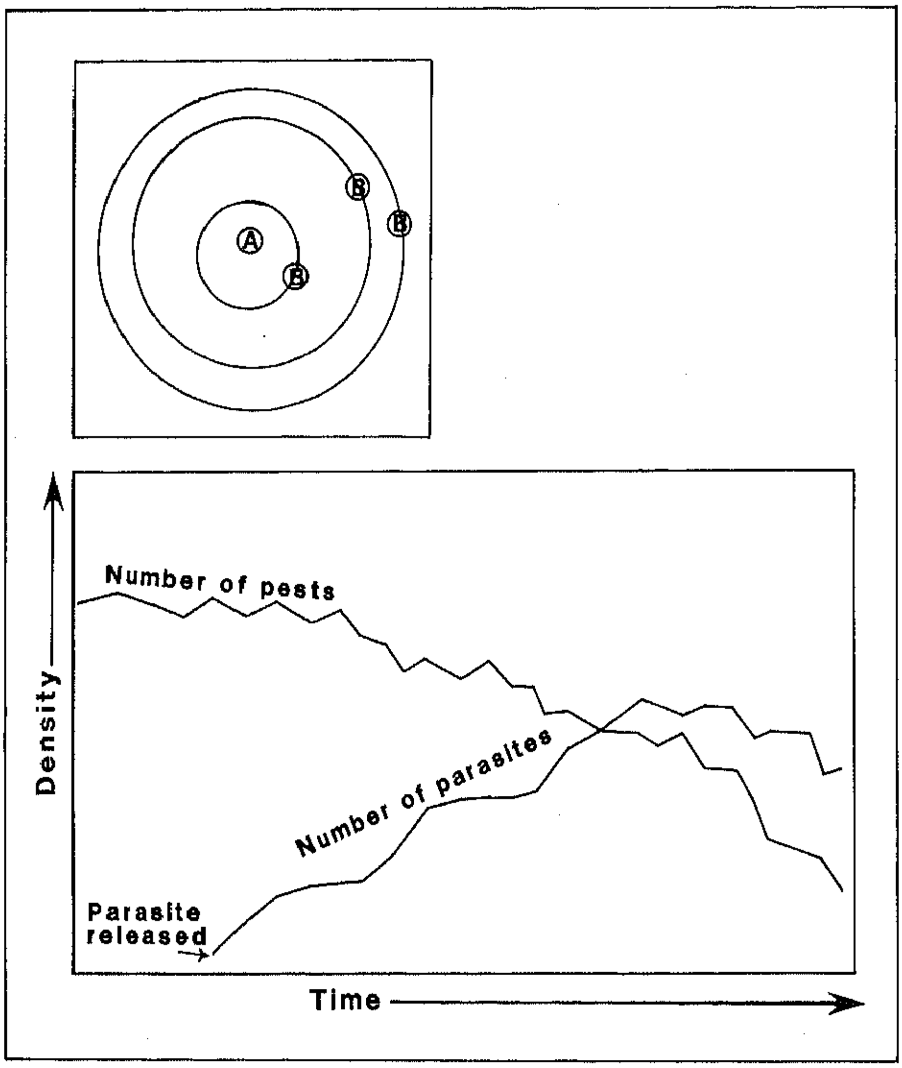
Releases, however, should be made in separate localities and under conditions that will permit evaluating the progress of each species. Ryan gives credit to Don Parker, who was chief of forest insect research at Intermountain Station, for his foresight in deciding to release only *A. pumila* in Idaho in 1960. Because no other parasite was released, it was a test of what *A. pumila* was able to do alone.

Long-term monitoring is important

Ryan says a vital element in any biological control program is to document what happens to both pest and parasites up to the time populations become stabilized at low levels. It is the only way to prove a connection between the presence of the enemy and the decline of the pest. Otherwise, there may always be a question about why the pest declined, he says. This means collecting data on pest density before parasites are introduced and regularly afterward. Sometimes introduced insects are not found for several years following release; some parasites do not adapt to local conditions and simply die out.

Because imported insect enemies may take a long time to become established, evaluations must continue for a long time. On the basis of his experience, Ryan now recommends that measurements be taken for 10 years—or even longer. This period is longer than Ryan had anticipated and about twice as long as most research plans call for.

To facilitate this evaluation, Ryan selected study sites about 50 miles apart. Three types of site were established. At one location, *A. pumila* was released alone; at a second, another parasite was released in addition to *A. pumila*. A third site was a check plot where casebearers, but no parasites, were present. Additional check plots were established at intermediate locations. Data collected at each site were then displayed on graphs to show the number of casebearers and number of parasites, by species, found at each point at each evaluation.



When parasites become established they spread in concentric circles from the release point. Counts of pests and parasites made regularly at check plots provide data that, over the years, indicate population trends.

A = point where parasites were released
B = check plots established at accessible locations at varying distances from release point.

In 1985, the fate of five of the seven parasite species was still uncertain. Ryan says it is too early to be sure whether they will increase or die out. He hopes to continue evaluations at some of the release sites for a few more years to find out.

Cooperators are necessary

Ryan has found that success in introducing foreign pest enemies depends on cooperation from a lot of people. Because the single most important ingredient—the imported natural enemy—is only available in a foreign country, the help of other scientists is needed for the collection, shipment, and quarantine screening of candidate species. Also important are entomologists and forest managers in the area of the domestic infestation and landowners whose forests are infested. Ryan is quick to single out for particular praise the cooperation extended by personnel at the USDA Agricultural Research Service quarantine receiving station at Newark, Delaware, because he was entirely dependent on their processing of all incoming material from abroad. This involved sorting the thousands of insects they received to separate out the beneficial species Ryan needed. They often did this under tight deadlines imposed by the perishable nature of the insects.

Entomologists abroad are vital sources of information about natural enemies and often are sources of insects. Several scientists have supplied Ryan with small numbers of desired species in exchange for material he could send them. In one case, Ryan exchanged specimens of a spruce budworm parasite from Oregon for specimens of a larch casebearer parasite from Poland.

The cooperation of forest managers is also essential. They supply information about the location and extent of infestations and provide help in releasing parasites and collecting larch branches for evaluation.

In some years of low funding, Ryan's work was supported entirely by landowners. Two of his strongest supporters were Kinzua Corporation and Boise Cascade Corporation, both of which faced potentially large monetary losses from the casebearer. They became involved in Ryan's research in 1975 and provided money to have parasites collected in Europe during years when government funds were short. Boise Cascade also provided study plots and manpower to move parasitized casebearers to new sites of infestation. This cooperation earned Boise Cascade an award from the American Paper Institute and the National Forest Products Association in 1985. One of Ryan's strongest supporters was the late Glenn Parsons, Chief Forester for the corporation in northeast Oregon. When the larch became heavily infested in the mid-1970's and insecticide spraying was being considered, Parsons was willing to wait and see what the parasites could do.

In 1985, when the Chinese contacted the Forest Service to request help with a casebearer problem in the northeast provinces of China, Ryan was asked to send specimens of *A. pumila* and *C. laricinellae*. With his contacts, Ryan had no trouble making arrangements. For one shipment, he simply called Fred Ebel of Boise Cascade, who was going to China on a technical visit, and asked him to deliver the insects to an entomologist at the Biological Control Laboratory in Beijing.

Ryan is a strong advocate of field trials. It is the only way, he says, to tell how parasites will perform. He would like to see more Forest Service researchers working with imported natural enemies for biological control. Some scientists apparently feel this approach holds no promise for particular pests. Others have tried and given up after failing with one species when others might have succeeded.

Advantages of using biological control

Although prospects for controlling some pests with enemies are better than for others Ryan says no pest is without hope. In the case of native pests, he says, it is sometimes possible to import the enemies of related pests from abroad. Importing and releasing enemies is not appropriate, however, unless low levels of the pest can be tolerated. When the intention is to eradicate a pest, as is currently the case with the gypsy moth in the Western United States, importing enemies is not the answer.

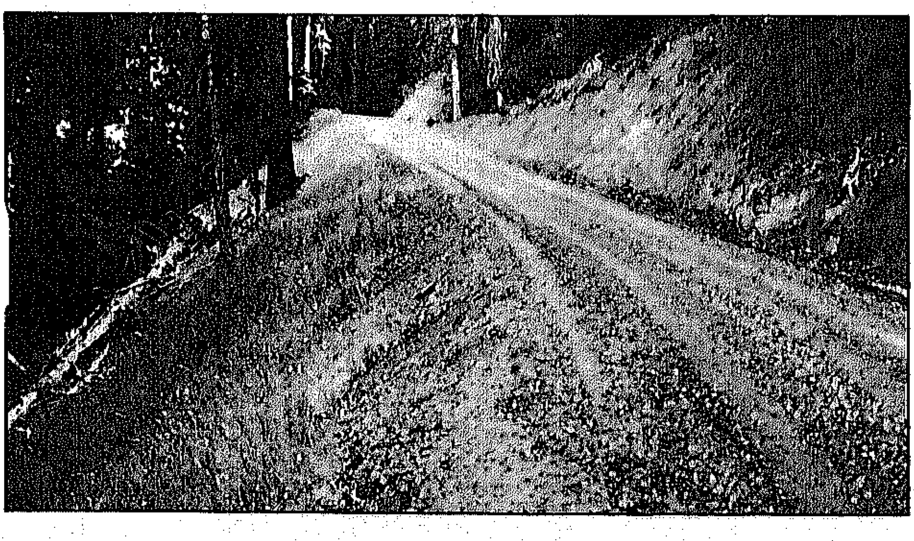
Ryan's 15-year experience with the larch casebearer has reinforced his convictions about the importance of natural biological control. To him, the use of imported natural enemies makes simple good sense: It is permanent. The enemies themselves are harmless and will always be available to keep the pest at low levels, or to check an increase in the pest if conditions should temporarily favor it. There are no continuing expenses after the enemies become established. And, finally, other elements of the ecosystem are not harmed.

Quantifying conventional wisdom— forest road research

by Mike Prouty
Intermountain Station

"The effects of clearcuts are reversible, those associated with forest roads are not. Twenty years after a clearcut—long after a new crop of trees is established and thriving—the original timber sale road will still be there, for better or worse. Mistakes made during the location and construction of that road will not go away, they'll only cause more problems and more resource damage."

Those introductory remarks made 10 years ago by the hydrologist teaching my forest watershed class penetrated even my early morning sophomore stupor. And today, with the Forest Service building about 10,000 miles of new roads each year, and expecting to do so for the next 30 years, those words appear as relevant now as they were then.



Intermountain Research Station scientists are working to help ensure that Forest Service roads built today do not develop into expensive, damaging eyesores. The Engineering Technology research work unit (RWU), based at the Intermountain Station's Forestry Sciences Laboratory in Moscow, Idaho, is one of five Forest Service engineering research projects in the country. However, the other four projects are geared to the traditional forest engineering topics of timber harvesting systems and equipment. Project Leader Ed Burroughs believes research directed toward forest roads is vitally important. "Timber sales aren't usually controversial because of the harvest system. If a sale is controversial it's usually because of high road costs and resource impacts," says Burroughs.

The mission of the research unit encompasses three areas related to forest roads. The group works to develop techniques to reduce costs and environmental impacts of road construction, they are devising methods to estimate road surface erosion and treatments to deal with this problem, and they are developing a planning framework for evaluating landslide hazards. RWU members in addition to Burroughs are Research Engineer Rod Prellwitz, Research Geologist Carol Hammond, Research Hydrologist Patty Heumier, Hydrologic Technician Andy Lawrence, and Systems Analyst Paul Swetik. Over the last several years, the research unit has worked closely with cooperators, including the civil engineering and geological engineering

In the past, forest roads were built wide, straight, and fast (top). Such roads have now given way to low-impact roads (bottom) that fit the forest terrain and minimize resource damage.

departments of the University of Idaho (U of I), the University of Montana's geology department, the Nezperce National Forest, and the Forest Service Northern Region's engineering staff.

Dispelling the "freeway syndrome"

"After World War II, forest roads were built wide, straight, and smooth. A road was evaluated on the size of truck it could handle, and how fast that truck could get out of the woods," says Burroughs. This "freeway syndrome" often resulted in severe environmental impacts and high road construction costs, especially when roads began to be built on steep, rugged ground. Soon a growing environmental awareness and a concern for cost effectiveness changed all that. Current construction guidelines emphasize low-impact roads that fit the terrain and minimize resource damage and road construction costs.

Conventional road-building equipment, such as D-8 cats, was used to build these high-standard forest roads because of the increased amount of excavation required. But as guidelines have changed, so has the equipment contractors use to build smaller roads. Burroughs succinctly states the problem, "It's hard to build a 12-foot road width using a 14-foot blade of a D-8 cat!"

And so in recent years, large hydraulic excavators—better known as backhoes—are being used with increasing frequency. "Contractors have found backhoes to be versatile and effective. They can clear, grub, and excavate faster than cats, because they can do it all in one pass. And in the opinion of research engineers, the combination of lower standard roads and the use of backhoes creates less resource damage than conventional equipment. Cats just push, slash, backhoes can pick it up, shake out the dirt, and place it aside. Cats often have to wallow in wet, sensitive soil areas, but backhoes never leave the road surface," says Burroughs.

An interesting story. But how does this relate to forest engineering research? Research work unit personnel, in cooperation with Dr. Donald Haber of the U of I's department of civil engineering, are quantifying this conventional wisdom in several ways. While contractors have been reducing the use of D-8's—discovering it's easier and cheaper to build forest roads with backhoes—the Forest Service system of estimating road costs is still based on production rates for conventional road-building equipment. By doing production studies on the backhoe, the research unit will produce new cost equations for Forest Service road cost guides in the Northern and Intermountain Regions. Once in place, these equations will allow Forest Service engineers to more accurately estimate the cost of road construction in the timber sale planning process.

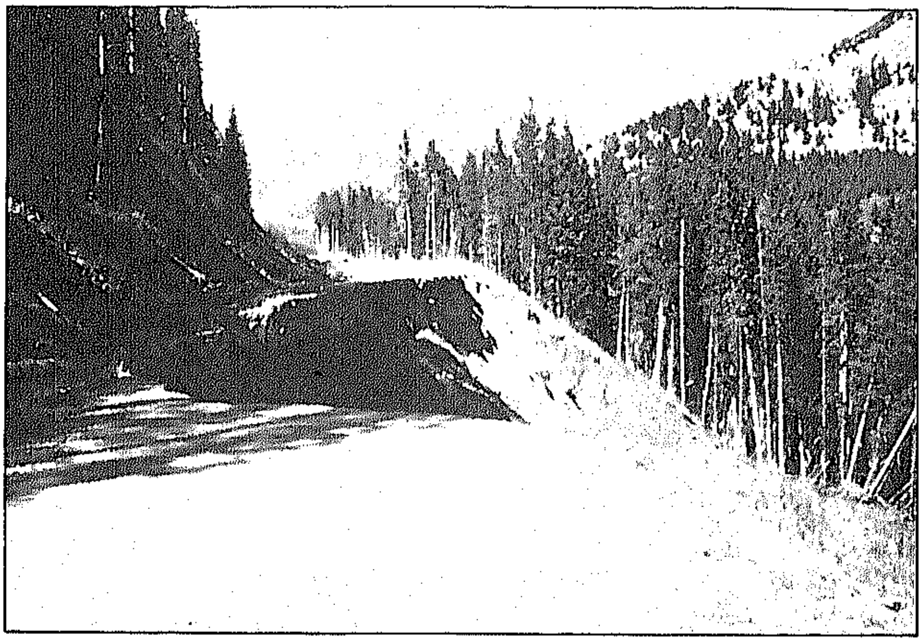
Backhoes are a versatile, efficient equipment being used more frequently in forest road construction.

Personnel from the engineering research work unit are putting these new cost guides into programs—accessible on the service-wide Data General (DG) computer system—thus replacing the antiquated paper worksheets presently in use. The result will be quicker, more accurate, and better documented road cost estimates.

In the past, working through a myriad of tables and guides during the road cost estimate made the job a laborious, time-consuming exercise. Road designers, who are often the cost estimators, were reluctant to examine alternative road designs because it often meant an entire redo of the process. By putting the new cost guides on the DG, flexibility is gained in the design and estimation process. Now designers can quickly and easily analyze the costs of various design alternatives.

Predicting erosion from roads

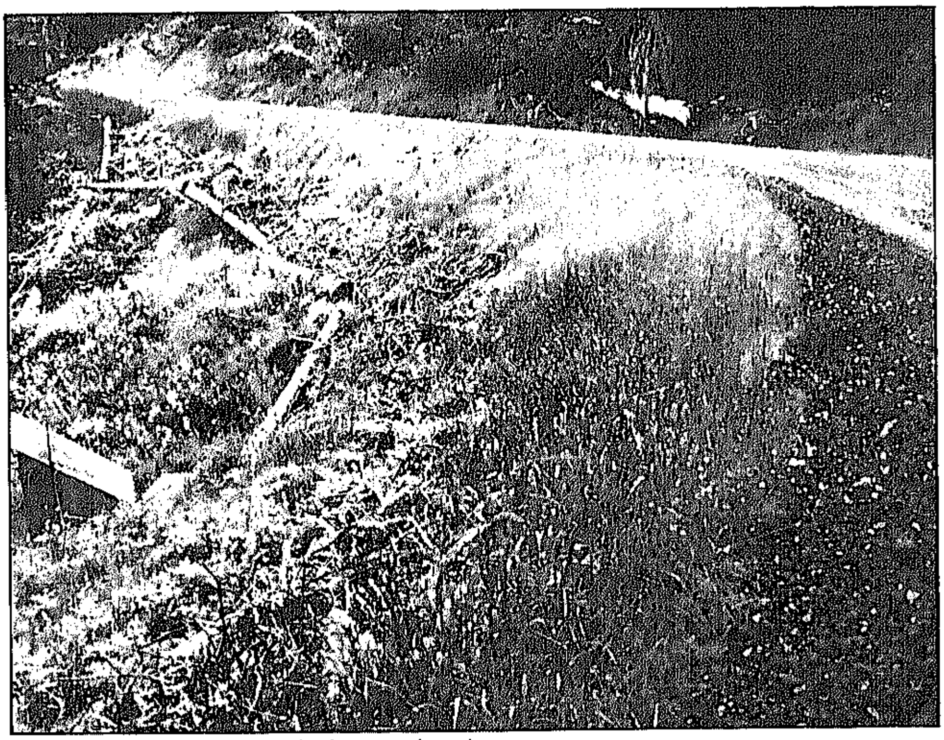
As part of their second research topic, the research unit is developing an erosion control design package for use on the DG. These programs will be developed from research that compares the cost of erosion control treatments to their effectiveness in reducing sediment. With access to both the road cost guide and erosion control packages, road designers will be able to compare road alternatives with factors such as road location, grade, surface material, and erosion control treatments. This new technology will display for managers the tradeoffs between the cost of alternative road specifications and corresponding levels of resource protection.



Many mass failures that result from management activities can be avoided with careful advanced planning.

How do you predict how much sediment will result from a forest road? If prediction were possible for a given type of road in a given location, planners could confidently tailor the design of a road to specific requirements dictated by terrain and resource protection. Predicting and minimizing sediment yields from roads greatly concerns forest engineers, fish biologists, and forest hydrologists.

Explaining the physical processes that cause soil particles on a road surface to wash into streams involves physics, chemistry, and mathematics. Hypothetical models that attempt to explain the process of erosion have already been developed. Research work unit members, in their effort to develop a reliable predictive tool for forest managers, are comparing and modifying these equations—and testing their accuracy and practicality in forest road situations.



Slash material placed along the bottom of road fills are called filter windrows, and by trapping runoff, can reduce sediment yield by 85 to 90 percent.

"The action of rainfall, snowmelt, and road traffic, among other factors, causes roads to erode. We've developed two ways to study how accurately existing models predict this process," says Burroughs. The group is placing electronic equipment alongside sections of forest roads in Idaho to monitor the effect of normal, everyday activity on road surfaces.

The second method, a complicated sprinkler system that simulates a rain shower, has allowed Forest Service scientists and U of I cooperators the flexibility to quickly compare the effect of a known amount of precipitation at a known intensity on a variety of road surfaces and designs. Data from this "rainulator" and from the instrumented road segment studies is leading to the development of tables and DG programs that display the cost effectiveness of erosion control treatments.

Preliminary results show, for example, that by merely putting gravel on a road surface, 76 percent of the sediment from the surface would be eliminated. Managers can compare the cost-effectiveness of a gravel road to an unsurfaced road. There are many other treatments available for reducing sediment from fill slopes and cutslopes, and the RWU is studying the cost-effectiveness of these treatments. For example, filter windrows composed of slash material can be built by a backhoe during initial construction of a road, with only a nominal cost increase. These windrows, constructed along the fill slope, can reduce sediment yield by 85 to 90 percent. Given this kind of information, managers can weigh the value of the resource with the cost of its protection.

Avoiding problems before they occur

\ll the cost-effective road construc-
ion techniques, together with cost-
effective surface erosion control
reatments are useless if the road
tself is incorrectly located and
auses a landslide. So the third study
rea of the engineering research
vork unit—landslide evaluation for
planning purposes—assumes added
mportance.

Engineer Prellwitz and Geologist
Hammond are working to develop a
ystem of identifying and predicting
he stability of ground at three levels
f forest planning. The first level is a
road planning approach, encom-
assing a large area, such as a
vatershed or a large portion of a
anger district. A map of general
otential landslide hazards within the
ntire area is developed in this effort
o aid in planning future management
ctivities. Level 2 planning focuses
nore precisely on landslide hazards
t the project level—a proposed road
ocation or timber sale within the
rger area. At this level, a detailed
nap is made showing areas of insta-
ility, and some additional field mea-
urements are made at these areas
o better define potential problems.

Level 3—the most detailed phase in the process—looks at site specific problem areas within a project. This planning level may require soil shear strength tests and groundwater studies to design specific measures such as retaining walls, underdrains, or perforated pipe to increase stability along a particularly unstable road location.

By developing a universal, accepted methodology for this planning process, Prellwitz, Hammond, and U of I cooperators hope to standardize planning procedures for National Forests. They feel such a methodical planning process will identify most of the unstable areas on timber sale road locations and harvest areas and thus help avoid devastating landslides.

A fresh landslide, a road washout, or the thick coffee-color of a once clear forest stream are sobering sights. Knowledge gained by the Intermountain Station's Engineering research work unit is helping make the planning, design, and construction of forest roads a more cost-effective, resource-sensitive proposition.

My old watershed instructor was right—forest roads can be valuable long-term investments or they can be costly problems that won't go away. The information research is producing will help reduce the liability of planning, designing, and constructing roads in our National Forests.

New publications

A framework for wildlife and fish assessments

National assessments of wildlife and fish, as carried out by the USDA Forest Service, are integral parts of national resource planning. In addition to the traditional analyses of the status and condition of wildlife and fish resources, national assessments should project inventories and use, and analyze opportunities and implications for changing the future resource situation.

A new report published by the Rocky Mountain Station details the technical components necessary for making national assessments of wildlife and fish. Wildlife biologists and other resource specialists will find the report offers guidance on the data needs and analysis procedures useful in developing the mandated periodic reports to Congress.

Copies of *National Assessments of Wildlife and Fish: A Technical Framework*, General Technical Report RM-122, are available from the Rocky Mountain Station.

Port-Orford-Cedar reviewed

Port-Orford-cedar logs have historically brought high prices. Current exports—mostly to Japan—bring higher prices than any other North American conifer. Although the species grows in a limited area along the Pacific Coast in southwest Oregon and northwest California, it grows on a wide variety of soil types, tolerates a wide range of temperatures, and grows with many other tree species.

Port-Orford-cedar grows in shade and reproduces in old-growth stands. It can be both a pioneer and a climax species in the same stand. It is most dominant on wet, cool sites, and reaches its largest size and commercial value on productive soils near the northern limit of its range. The species appears to be more sensitive to the availability of water than most conifers of the region but less sensitive to soil nutrient status or temperature.

Port-Orford-cedar has few biotic enemies, but a root rot caused by the pathogen *Phytophthora lateralis* that attacks only Port-Orford-cedar has spread throughout its range since 1952. It is serious because there is no known genetic resistance or established chemical control. The root rot is spread by spores in mud that is moved around by people, machinery, and animals and underground between tree roots.

A new publication from the Pacific Northwest Station summarizes information about the biology and management of Port-Orford-cedar and includes recommendations for its management in the presence of the pathogen. Information is based on the technical literature and unpublished data. For copies, write to the Pacific Northwest Station and ask for *Ecology, Pathology, and Management of Port-Orford-Cedar* (Chamaecyparis lawsoniana), General Technical Report PNW-184.

Water transfer and storage of logs

The coves and bays of the Pacific Northwest and southeast Alaska that are often the most biologically productive portions of estuarine systems often are the best places to transfer and store logs. The environmental effects of transporting, sorting and storing logs on fish habitat are discussed in two new publications from the Pacific Northwest Station.

Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America, Water Transportation and Storage of Logs, General Technical Report PNW-186, includes an historical review of how transporting logs by water 100 years ago changed stream channel structure and resulted in habitat losses. The report also reviews the effects of current log handling on physical habitat, water quality, plant communities, benthic and intertidal invertebrates, and fish. Guidelines and recommended practices developed by a west coast task force to minimize adverse environmental impacts are included.

Log Transfer and Storage Facilities in Southeast Alaska: A Review, General Technical Report PNW-174, summarizes the features of log transfer facilities, presents ideas on siting and engineering design, and reviews the impacts of timber harvest on intertidal and estuarine habitat. Although timber harvest in southeast Alaska began in the early 1900's, it was not a major influence until the 1950's. Nearly all the timber harvested between 1909 and 1983 (about 15 billion board feet) was transported by water to processing plants. The environmental problems caused by log transfer and storage in estuarine habitat have been of concern to fishery biologists since the early 1970's.

For copies of the new reports, write to the Pacific Northwest Station.

PROGNOSIS model extended

Managers in the Northern Rocky Mountains have used the stand PROGNOSIS model to simulate stand growth and to compare the effects of different management practices on stand development.

Now Research Forester Melinda Moeur of the Intermountain Station has developed an extenstion of the PROGNOSIS model, called COVER, that models the development of tree crowns and understory vegetation. A new report describes how this new computer model provides three types of information: a description of the amount of cover and foliage in the tree canopy, the height and cover of shrubs, forbs, and grasses in the understory, and a summary of overstory and understory cover and biomass for a stand.

The possible applications of COVER are many. Among these, it can be used to examine the effect of silvicultural treatments on forest stand characteristics such as thermal cover, hiding cover, and browse production for wildlife. It can be used to predict the dynamics of shrubs and how they will compete with regeneration after timber harvest. The COVER model also can be used to examine the effect of canopy and ground cover on insect pests and hydrologic characteristics of a stand.

Request *COVER: A User's Guide to the CANOPY and SHRUBS Extension of the Stand Prognosis Model,* General Technical Report INT-190.

☆ U. S. GOVERNMENT PRINTING OFFICE 1986: 671-551/45,167

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- ☐ *The Role of the Genus Ceanothus in Western Forest Ecosystems*, General Technical Report PNW-182.
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Index of Rocky Mountain habitat types now available

The Rocky Mountain Station has just issued a report that indexes habitat types, community types, and plant communities for the major tree species in the Rocky Mountains. The 105-page report includes the name, location, site, successional status, principal tree and understory associates, and the authority for the classification for plant associations where interior *Pinus ponderosa*, interior *Pseudotsuga menziesii*, interior *Abies concolor, Picea pungens, Populus tremuloides, Pinus contorta, Picea engelmannii*, and *Abies lasiocarpa* are primary species.

Major Habitat Types, Community Types, and Plant Communities in the Rocky Mountains, General Technical Report RM-123, is available from the Rocky Mountain Station.

Petroleum exploration and wildlife

Rapid increases in petroleum exploration and development on public land pose potential problems to wildlife habitats. A new report from the Intermountain Research Station documents the sequence of events associated with environmental disruptions involved in the exploration, development, and production of petroleum.

The report, a cooperative effort with Ecologist Marianne Bromley, provides managers with a bibliography of literature on effects of land use activities. It also presents a general description of possible approaches managers can take to minimize negative effects to wildlife. Bromley identifies the major wildlife groups affected by petroleum activities as ungulates, carnivores, water birds, upland birds, and raptors. However, she states the potential impact of development is site specific and depends on the sensitivity of the species affected by the disturbance.

To obtain a copy of the report, request *Wildlife Management Implications of Petroleum Exploration and Development in Wildland Environments*, General Technical Report INT-191.

Classification for central and southern Utah forests

The Intermountain Station has completed a classification of forest environments of central and southern Utah. The work included sampling over 720 forest stands on four National Forests and other Federal land to develop a classification system based upon the potential vegetation for the forest lands.

The report, written by Forest Service Ecologists Andrew P. Youngblood and Ronald L. Mauk, describes the classification system, provides a key to help in field identification of 37 habitat types, and describes the composition of mature forest communities in the area. The classification system provides a common frame of reference for managers responsible for a broad range of resources. Similar classifications are now in use by land managers and researchers in more than 20 areas in 10 western states.

Request *Coniferous Forest Habitat Types of Central and Southern Utah*, General Technical Report INT-187.